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UNITED STATES DEPARTMENT OF AGRICULTURE
Washington 25, D. C.

CURRENT DEPARTMENT RESEARCH ON PACKAGING AND CONTAINERS

AS OF JULY 1, 1953



August 1953

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This report was prepared by the Departmental Packaging and Container Working Group under the chairmanship of a representative of the Office of the Administrator, Agricultural Research Administration, to provide a concise statement of research under way in this field. A similar report was released in September 1952 summarizing the research under way as of July 1, 1952. In the current report, a statement on the status of each project has been added, and a list of projects completed or discontinued in the past year is included. Agencies within the Department participating in the work are indicated by abbreviations, and are as follows:

Bureau of Agricultural Economics.....	BAE
Bureau of Agricultural and Industrial Chemistry.....	BAIC
Bureau of Animal Industry.....	BAI
Bureau of Dairy Industry.....	BDI
Bureau of Entomology and Plant Quarantine.....	BEPQ
Bureau of Plant Industry, Soils, and Agricultural Engineering.....	BPISAE
Farm Credit Administration.....	FCA
Forest Service.....	FS
Office of Experiment Stations.....	OES
Production and Marketing Administration.....	PMA

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I. PRODUCT REQUIREMENTS

Research on the physical, chemical, and biological properties of agricultural products to determine the requirements for packaging.

A. Horticultural Products

Prevention of losses in yield and quality from enzymatic browning in dehydration, concentration, and freezing of fruits. Deals in part with effect of composition of sirup and volume of air space in container on appearance and storage stability of frozen fruits, particularly peaches. Status: Tannin components of Elberta peaches have been isolated and separated into four distinct components. Analyses will be extended to other varieties.

(BAIC #1)

Determination of shelf-life of heat-processed (canned) Concord type grape juice concentrate from Western grapes under the range of temperature conditions encountered in military and civilian use. This is a sterile product and must be packed in hermetically sealed containers. Therefore, the effect of glass and metal containers on the product will be studied. Status: Storage studies are still in progress.

(BAIC #2)

Development of processes for preparing strawberry juice and concentrates thereof from sound cull fruit to conserve essential food and reduce packing house waste. Deals in part with the effect of tin and/or glass containers on the quality of the product during storage. Status: Work thus far has shown that gel formation is not correlated with pectin content, enzyme activity, or the maturity of the fruit from which the juice was obtained. Work is being continued.

(BAIC #3)

Prevention of losses in yield and quality from enzymatic browning in dehydration, concentration, and freezing of fruits. Deals in part with effect of composition of sirup and volume of air space in container on appearance and storage stability of frozen fruits, particularly apricots. Status: Inactive at present.

(BAIC #4)

Development of low-moisture dried peaches for military use. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Drying to about 5 percent moisture content can be accomplished at low temperatures in a vacuum dryer. Drying at higher temperatures resulted in considerable browning. Studies are being continued to reduce drying time.

(BAIC #5)

Development of improved dehydrated products from blueberries and cranberries for military rations and essential civilian needs. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Inactive at present.

(BAIC #6)

Development of full-flavored dried apple products, such as nuggets and powdered sauce, from Eastern grown fruit. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Project is pending. (BAIC #7)

Development of a pasteurized or frozen concentrated tomato product suitable for reconstituting as a juice to conserve military storage and shipping space. Products will be in hermetically sealed containers, and, therefore, the effect of metal or glass containers on the product and its quality during storage will be investigated. Status: Storage tests are still in progress. (BAIC #8)

Application of dehydrofreezing to the preparation of high-quality dehydro-frozen lima beans (a concentrated frozen product affording economy in freezing storage space) for feeding of Navy personnel. Includes a study of the chemical and physical characteristics of the product as a basis for packaging needs. Status: Studies are being continued to prevent cotyledon separation, and to further define optimum conditions for preparing the product. (BAIC #9)

Protection of dehydrated mashed potatoes (potato granules), a military ration item, against oxidative deterioration during storage, by the use of phenolic antioxidants. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Storage tests are still in progress. (BAIC #10)

Development of methods for preparing dehydrofrozen green beans (a concentrated frozen product affording economy in freezing storage space) for feeding of Navy personnel. Contains in part a study of the physical and chemical characteristic of the product as related to packaging needs. Status: Type of cut exerts a marked influence on the product. Studies are being continued to determine optimum conditions both as to type of cut and processing procedure. (BAIC #11)

Development of ready-to-eat highly nutritious rations for the armed services based on compressed potato chips. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Suitable formulas are being developed, and field tests are being made on samples of compressed chips. (BAIC #12)

Preparation of stable low-moisture powders from orange juice. Includes determination of packaging and storage conditions under which these powders can be kept. Status: For long shelf life, moisture content of the product must be less than 0.5 percent, which can be achieved best by in-package dessication. Work to continue. (BAIC #13)

Factors affecting shelf-life of dehydrocanned apricots. Includes study of shelf-life as affected by various types of tin-plate containers and various degrees of oxygen pressure in the containers. Status: Some completed storage tests show that the product processed by present procedures is not stable enough to comply with military storage requirements. Work to continue. (BAIC #14)

Factors affecting shelf-life of dehydrocanned apples. Includes study of shelf-life as affected by various types of tin-plate containers and various degrees of oxygen pressure in the containers. Status: Preliminary results indicate that dehydrocanned apples are similar to canned apples in storage stability and quality, but conserve storage space and containers. (BAIC #15)

Determination of optimum processing time and temperature for concentrated peach puree. Includes study of storage changes associated with package atmosphere, temperature, and type of containers. Status: Work is along the same lines as for apricot puree. (BAIC #16)

Determination of optimum processing time and temperature for concentrated apricot puree. Includes study of storage changes associated with package atmosphere, temperature, and type of containers. Status: Several procedures for preparing the puree have been investigated. It has been found possible to concentrate to about 22 percent solids in a conventional falling film evaporator. (BAIC #17)

Determination of optimum processing time and temperature for concentrated juice from French prunes. Includes storage studies to determine effects of temperature, degree of concentration, type of container, deaeration and added ascorbic acid on the shelf-life of the product. Status: A series of products has been investigated. One product is a 2.5-fold concentrate which carries the flavor of the fresh prune. Work to continue. (BAIC #18)

Determination of optimum processing time and temperature for concentrated juice from Italian prunes. Includes storage studies to determine effects of temperature, degree of concentration, type of container, deaeration and added ascorbic acid on the shelf-life of the product. Status: Similar to French prunes. (BAIC #19)

Preparation of full-flavor juice concentrates from Eastern apples, grapes, cherries, blackberries and strawberries. Includes study of the effects of different packaging methods and separate in-packaging of apple juice essence with the concentrates on storage changes. Status: Full-flavored superconcentrates from apples, grapes, and cherries are undergoing storage and quality tests. (BAIC #20)

Methods of harvesting, storing, and handling sweetpotatoes. Includes studies of container, time, temperature, and humidity relationships in the storage house. Status: Decay of sweetpotatoes was reduced with diphenyl crate liners. Various curing treatments are under test at Meridian, Mississippi. Project to be continued. (BPISAE #1)

B. Animal and Poultry Products

Behavior of lamb meat exposed to and protected from air in freezer storage. Observe changes in lamb meat stored (1) wrapped in cellophane, (2) vacuum packed in tin plate cans, (3) packed in tin plate cans under an atmosphere of carbon dioxide, and (4) packed in tin plate cans under an atmosphere of N₂. Status: Some early results have been published. The reaction of lamb meat stored in vacuum at +15° F. was favorable. It is planned to study the effects of no protection, cellophane wrapping, and CO₂ atmosphere in tin can at temperatures ranging from 0° to 25° F. (BAI #1)

Processing in relation to preservation of quality and nutritive value of meats. Study the effects of current packaging materials on quality retention of frozen and cured meats during storage from 100° F. below to 110° F. above zero. Duplication of freezer locker plant conditions of storage of fresh and cured meats, using packaging materials currently used by locker plant industry. Status: Various wrapping materials, including cellophane, aluminum foil, waxed locker paper, polyethylene, and cryo-wrap, have been used with pork loins frozen and stored at temperatures ranging from +2° F. to -90° F. for periods up to 12 months. Work is continuing on these phases. (BAI #2)

Prepackaging of retail cuts of fresh and cured meat. Study to determine the significant biochemical changes and the role of microbial flora of meat that are involved in the deterioration of retail cuts of prepackaged meat and to devise and develop improved protective packaging methods, with or without associated means, for inhibiting or minimizing the deteriorative changes that occur in such product. Status: Contract project with New Jersey Agricultural Experiment Station. Studies have been completed and final report is in preparation. (BAI #3)

Development of dry honey-milk products for use in prepared baking mixes and in highly nutritious beverages suitable for military convalescence. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: A contract is still under way dealing with the use of these products in prepared baking mixes. Several bakeries have shown interest in the use of these products in bread mixes. (BAIC #21)

Development of means for retarding flavor and texture changes in precooked frozen turkey meat dishes suitable for meal service where preparation time or facilities are limited (e.g., on airplanes). Includes an investigation of best sizes of meat to use and utilization of liquid and dry packs as related to packaging needs. Status: Extended storage tests have shown that rancidity developed during cooking can be decreased by cooking the birds in water containing an antioxidant. Work is being continued. (BAIC #22)

C. Other Food and Feed Products

Development of an "instant" rice (prepared for serving by adding boiling water) for military and civilian use. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Research is being continued to provide basic information essential to the formulation of processes to provide more stable quick-cooking rice. (BAIC #23)

Determination of optimal conditions of temperature and humidity for storage of dry beans and peas in order to define proper warehouse facilities for military use. Includes the effect of oxygen, air, light, and moisture exchange on the appearance and edible quality of the product with view of applying information on proper packaging material. Status: Storage tests are being continued in order to establish relative stability of samples of intermediate and low moisture contents. (BAIC #24)

Stabilizing candies for use in military rations. Includes a study of incorporation of humectants, antioxidants, and emulsifying agents, and the effect of air, oxygen, light, and moisture exchange on appearance and edible quality of the product as a basis for packaging needs. Status: Work is being continued in cooperation with the National Confectioners' Association. (BAIC #25)

II. DEVELOPMENT AND EVALUATION OF CONTAINERS

Development of improved containers and evaluation of containers in terms of their functional purposes, such as (1) preservation of quality during handling, transporting, storing and merchandising; (2) trade and consumer acceptance; and (3) minimizing costs.

A. Horticultural Products

Prevention of insect infestation in packaged dried fruits and nuts. Develop insect-proof packages and methods of treating these commodities during packing to insure an insect-free product. Status: This study is quiescent pending results of other tests. (BEPO #1)

Antiseptic treatments for control of post-harvest diseases of horticultural crops. Application of fungicides to the container, liner, or packing material. Test and develop methods of controlling diseases such as improved handling and packing methods, and use of disinfectant washes and wraps. Status: Numerous compounds under test as pre-harvest sprays, post-harvest dips and as fumigants or for impregnating wraps, liners, and cartons to reduce decay. Project to be continued. (BPISAE #2)

Problems in shipment of horticultural crops by rail. Study of the transit services offered by railroads, the performance of equipment, methods of loading, types of containers, and other factors influencing the biological or physical conditions of the transported commodities. Status: Numerous shipping tests conducted on at least 12 different fruits and vegetables in the past year. Project to be continued. (BPISAE #3)

Problems in shipment of horticultural crops by highway transport. Study of the transit services offered by highway transport, the performance of truck equipment, methods of loading, types of containers, and other factors influencing the biological or physical condition of the transported commodities. Status: Test shipments conducted on cooling of Florida tomatoes in field crates, cooling of oranges in mesh and polyethylene bags, disposable honey-comb paper floor racks, etc. Project to be continued. (BPISAE #4)

Problems in the shipment of horticultural crops by air. Develop and test packaging, containers and other methods and equipment for protection against heat and cold. Status: Report recently published cooperatively by University of California and U.S.D.A. on recommendations for air shipment of fruits and vegetables. Project to be continued (BPISAE #5)

New containers and packing methods for horticultural crops. Determine suitability of new types of containers for different commodities, how well the contents can be precooled and refrigerated in transit and storage, advantages of various methods of packing, need for paper wraps, etc. Status: Tests continuing on half-box fiberboard cartons for lemons and oranges, fiberboard cartons for dry-packed lettuce; polyethylene box liners for pear storage, etc. Project to be continued. (BPISAE #6)

Prepackaging fruits and vegetables. Determine types of films best suited for prepackaging fruits and vegetables, study moisture loss, change in nutrition value, quality, gas exchange, disease control, need for ventilation and appearance of films. Status: Transparent films for carrots, onions, sweet-potatoes, radishes, potatoes, and apricots were tested during the past year. Project to be continued. (BPISAE #7)

Prevention of mechanical damage to fruits and vegetables in handling from field to consumer. Determine the effect of the package, liner, pads, packing method on bruising of fruits and vegetables. Status: Studies of apple bruising in packing plants and of potato injuries during digging and in transit are in progress. Project to be continued. (BPISAE #8)

Harvesting, handling, storage, and shipping effects on potatoes. Study the effect of storage environment in bin storage, 20 to 40 bushel crates, bushel crates, sacks, etc. on weight loss, storage life and culinary quality of potatoes. Conduct trials with consumer type packages. Status: Fifty-pound corrugated paper boxes for potatoes and 6 types of 10-pound consumer bags were tested under commercial storage conditions. Project to be continued. (BPISAE #9)

Cold storage of citrus fruit for off-season marketing. Study devices for increasing fruit storage life, including after-harvest treatments, wraps, etc. Status: Terminal market storage tests with diphenyl-treated fiberboard cartons and lined Bruce boxes for citrus fruits were continued. Some fiberboard cartons for oranges broke open during handling. Project to be continued. (BPISAE #10)

Packing and preservation of stored shelled nuts. The effect of commercial and improved packages on the storage and shelf life of shelled nuts when held at different humidities and temperatures similar to those in practice will be studied. Status: Data obtained during the year confirmed previous results on the improved keeping quality of shelled nuts held at 32° F. in sealed moisture proof bags over those stored in fiberboard boxes. Project to be continued. (BPISAE #11)

Improved methods for packing, handling, and shipping peaches. Make tests of new or improved packages and their effect on bruising. Determine relationship of decay to fungicidal treatments given during packing operations and in orchards, and the value of sanitary measures in handling and packing. Status: Post-harvest treatments to reduce decay were continued. Rhizopus rot was reduced by wrapping fruit in copper-impregnated paper. Project to be expanded. (BPISAE #12)

Improved wooden fruit and vegetable containers. Determine the requirements for picking boxes and for shipping containers used by fruit and vegetable growers in order to promote better utilization of forest products; improve existing designs or develop new containers that will give better performance at lower original cost; and, as regards shipping containers, reduce loss and damage claims, which increase consumer prices. Status: Improved some types of containers. Demonstrated suitability for containers of various species not previously used for this purpose. Will continue work on these phases. (FS #1)

Improved loading methods and containers for shipping agricultural commodities. Study the adaptability of present containers to efficient methods of loading and protection of the commodity, and recommend changes in containers. Conduct special refrigeration tests to determine the effect of various containers and container arrangements and load patterns on the efficiency with which the commodities (fruits, vegetables, and animal products) can be refrigerated. Status: Work completed and reports submitted for publication on loading methods and containers for lettuce and carrots, effect of top icing cars on container breakage of vegetables, loading methods for cantaloups. Field work completed on shipping of cauliflower and transportation tests of new tomato shipping container. Work under way on plum container should be completed in 1954. Work under way on lettuce in fibreboard containers is planned to be broadened in 1954 and 1955 to include transportation tests of other newly developed packages. Rearrangement of loading patterns of containers with frozen poultry in motortruck trailers found to increase efficiency of transit refrigeration. (PMA #1)

Packaging Iowa nursery stock for shipping and retail markets. Reduce shipping container weight and provide better preservation of plant material in distribution of nursery stock; develop containers for retail store display sales which will preserve the plant for a time under the unfavorable temperatures and humidity common in such sales outlets; study effects of ultra-violet lights in controlling molds and fungi in storage and on the dormancy and salability of nursery stock. Status: Several modified wraps were developed and costs compared with conventional wraps. Work will continue. (OES #1)

Improvement of containers for western fresh plums. Develop cheaper and improved containers in comparison with those now used. Status: Container manufacturers developed about 30 experimental plum containers of which two were selected by the contractor (California Grape & Tree Fruit League) for testing under commercial conditions during the 1953 season. (PMA #2)

B. Animal and Poultry Products

Improvement in the storage life and appraisal of health hazards of fresh cut-up poultry products by development of improved processing practices, with special emphasis on microbiological factors. Project includes influence of commercial packaging materials and/or processing methods on rate of spoilage. Status: Contract phases of the work have been completed. Research is being continued on other phases of the problem. (BAIC #26)

Packaging of dried skim milk in consumer-size packages. To determine the efficiency of various small packages for preservation of dry skim milk; and to formulate standards for a satisfactory type of small package. Deals with the ability of various packaging materials and types of construction to protect non-fat dry milk solids from deterioration in consumer-size packages. Status: The work is being done with facilities and personnel of the Bureau of Dairy Industry. Numbers of packages of different types were packed and placed in storage in the fall of 1952. Sample packages have been removed and tested from time to time and additional containers placed in storage as the space became available. Each package type is to be tested for 12 months. The experiment will be continued until tests have been made with all the important package types that are in use. (PMA-BDI #1)

Development of treatments to prevent insect damage to cured meats. Develop and evaluate wrappers or coatings, or treatments for them, to protect cured meats from insect attack. Status: Wrappers prevented cheese skipper infestation but encouraged cheese mites. Protective packing material is now under test. (BEPC #2)

Development of treatments to prevent insect damage to bristles, fibers, feathers, and finished textile projects. Includes tests on the protection of raw wool. Status: Bags treated with 5 percent DDT emulsion have protected raw wool stored in them from attack by clothes moths and carpet beetles for over 18 months. (BEPC #3)

Improving preparation of wool for cooperative marketing. Find and develop (1) superior packages for grease wool, and (2) substitutes for the jute bags now generally used. Status: Project practically inactive during past year but will be continued with cooperation of wool trade and package manufacturers. (FCA #1)

Economic and technical problems of marketing prepackaged meat. Determine effects of prepackaging practices on quality and color of meats and consumer acceptance of prepackaged meats and associated merchandising practices. Status: Progress satisfactory; results being obtained on problems involved. Expected to continue at least two years. (OES #2 - Mich. and Mo.)

Investigation of the extension of the storage life of frozen turkeys by use of antioxidants to retard rancidity development. Includes a study of film coating and use of gas packing. Status: Preliminary tests with coatings of acetostearin on turkey steaks with and without wax wrapping have given encouraging results. Work is being continued. (BAIC #27)

Temperature and humidity relationships in the infection of shell eggs by bacteria. Includes studies of microbiological infection of eggs with regard to moisture content of the cases, cartons, and egg shells. Status: Excessive moisture in egg cases was found to increase the number of eggs infected with micro-organisms. During storage excessive moisture was induced by casing wet eggs and by saturating one cardboard flat with water. Report issued. Work continuing. (BAI #4)

C. Other Food and Feed Products

Development of insect-resistant packaging materials. Develop packaging materials for grain and cereal products that will be resistant to attack by meal moth, flour beetles, weevils, and other stored grain pests. Status: Large-scale warehouse tests are now under way with treated bags, using a material and formulation found most effective in laboratory testing. (BEPC #4)

Evaluation of protective packages for cereal food and food products in trade channels. The most promising treatments for cartons and fabric or paper bags developed in BEPC project #4 will be carried into trade channels for evaluation of effectiveness under conditions of actual use in industry. Status: This study is quiescent pending developments in #4 above. (BEPC #5)

Feed bags as an item in costs of feed to farmers. To determine the types, kinds and sizes of bags used for feed and obtain some measure of their relative importance; the extent and methods of operation of bag return programs; the necessity for and methods used in cleaning, re-conditioning and sterilizing used feed bags; the impact of bulk delivery on the bag problems; and practical methods of lowering the cost of packaging feed to the mill and to the farmer. Status: Field work completed. Analysis and report in process of preparation. (FCA #2)

Determination of shelf-life of parboiled and instant rice products. Evaluate effects of light, heat, moisture, and type of storage atmosphere on changes in stored products. Status: Chemical and organoleptic tests are under way on rice stored at different temperatures. Work to be expanded to include changes in sugars and organic acids. (BAIC #28)

Films for packaging dry beans, peas, rice, lentils, etc. Determine the best cellophane weights for 1-, 2-, and 3-lb. packages; the best film to withstand adverse weather conditions and be suitable for all automatic bag making, filling and sealing machinery; suitable transparent film for window-front cartons and also adhesives for holding the window intact; and kinds of transparent packaging materials suitable for 4- or 5-lb. packages. Status: The work on this project will continue for two years. A progress report entitled "Trends in Packaging Materials and Equipment for Dry Edible Beans and Related Commodities" was issued in June 1952. (PMA #3)

D. Other Products

Exploratory tests of new materials and methods for the control of insects in stored tobacco. Includes in part the evaluation of treated or insect-resistant containers for tobacco in storage or tobacco products in trade channels. Status: This study is quiescent pending results of tests in BEPC project #4 (p. 8). (BEPC #6)

Master containers for reducing transit damage and costs. Determine the practicability of using master containers, pallets, or unit loading methods in shipping agricultural commodities and processed foods by rail and truck to reduce transportation damage and handling costs. Status: Preliminary studies of large, pallet-type master containers have indicated that transportation costs incidental to their use outweigh the potential saving in labor of loading, unloading, and handling. No work currently under way on palletizing of existing containers for shipment due to current basic changes in types of containers being used. May be undertaken in 1955. (PMA #4)

III. DEVELOPMENT AND EVALUATION OF CONTAINER MATERIALS

Research in this field includes: (1) development of improved or cheaper packaging materials through new technological processes and use of different raw materials, (2) development of materials with special properties, and (3) evaluation of the fundamental properties of packaging materials that have general application, such as strength and insulating qualities.

Chemical survey of newly introduced or developed grain types. Project includes study to find a high-amylose starch for use in making transparent films for packaging foods for the Armed Forces. Status: Among 250 corn samples studied, one was found containing starch of about 60 percent amylose content. Studies are being continued. (BAIC #29)

Pilot-plant development of a wet separation process for dividing sugarcane bagasse into fiber to conserve pulpwood supply and into pith to improve marketability of molasses for feed. Includes use of bagasse fibers for making pulp, board, and paper. Status: Significant progress has been made in separating pith and fiber using a wet method, then drying the mass followed by subsequent separation of pith and fiber by dry screening. (BAIC #30)

Development of the mechano-chemical pulping process for sugarcane bagasse and straw. Includes improvement in corrugating board for containers to meet military requirements. Status: The mechano-chemical process requires more chemicals than the pressure pulping methods but yields are higher by the mechano-chemical process. (BAIC #31)

Semi-commercial-scale trials of the Northern Laboratory processes for converting bagasse into boards. Project deals with making acceptable board for commercial shipping containers. Status: Work is being pursued under contract. (BAIC #32)

Development of the mechano-chemical pulping process for sugarcane bagasse and straw. Includes preparation of liner board to extend kraft pulp. Status: Research contract has been let with New York State College of Forestry to produce several tons of liner board. (BAIC #33)

Evaluation of fiberboard for containers. Develop better fiberboard boxes and extend their field of utility through the correlation of the performance of the box with the strength of the fiberboard and the properties of the paperboard; develop methods of more accurately evaluating the properties of fiberboard materials for shipping containers. Status: Correlation phase completed for corrugated fiberboard boxes, continuing for solid fiberboard boxes. Various factors affecting serviceability will be studied. (FS #2)

Improving pallets. Make available to shippers and manufacturers a rational method for the design of pallets in order to bring about more efficient use of forest products. Status: Value of various designs and species determined. Work will continue on additional designs and species. (FS #3)

Southern woods for pulp and paper. Increase the utilization of southern woods for pulp, paper, and allied products. Status: Suitability of various species for container board determined. Work will continue on other species, especially little-used hardwoods. (FS #4)

Western woods for pulp and paper. Increase the utilization of western wood species for pulp, paper, and allied products. Status: Evaluation of various species including logging and mill wastes, for container board completed. Evaluation of other selected species will continue. (FS #5)

Eastern and Lake States wood for pulp and paper. Increase the utilization of these woods for pulp, paper, and allied products. Status: Suitability of number of species for container board determined. Work will continue on additional species. (FS #6)

Uses of pulp from wood grown on the farm. Investigate the suitability of selected species of southern hardwoods (oaks) for use as corrugating and liner boards, insulating board and hardboard, roofing felt and white paper. Status: Evaluation of some species for corrugated and liner boards completed. Study of other species will continue. (FS #7)

IV. IMPROVEMENT AND EVALUATION OF PACKAGING OPERATIONS

Includes investigations of the organization, facilities and equipment, labor utilization, and product quality in packaging operations. Evaluations are made in terms of costs, output per man-hour of labor, and return per dollar invested. Effect on product quality may also be involved as in the case where the bruising effects of different packaging mechanisms are being compared.

Improved equipment and standard plans for Michigan fruit packing sheds. Develop plans for efficient packing house operations and reduce mechanical injury to fruit (apples, peaches, and pears). Status: The possibility of transporting sour cherries in water by tank trucks from the orchard to canneries is being tested. Publications issued on how to reduce apple bruising, etc. Project to be continued. (BPISAE #13)

Cost of packing and packaging citrus fruits in Florida and Texas. Determine the costs of packing and handling citrus fruits in various types of containers in Florida and Texas. (A joint study with the Florida and Texas Agricultural Experiment Stations.) Status: Data collected and published annually since 1947 for fresh and since 1950-51 for frozen concentrate. Work will be continued. (FCA #3)

Efficiency of Florida citrus fruit packing house operations. Measure the efficiency of packing house operations in terms of varying types of organizations and operations and different handling techniques to provide a basis for reducing costs in packing Florida fresh citrus. Status: Work will continue and will include a study of bulk shipment by truck, with the fruit being packaged in the receiving market. (BAE #1)

Consolidation of citrus packing houses in Florida. Study of possible effects of merging two or more packing houses on sales and on operating efficiency. Status: Field work completed. Analysis under way. (FCA #4)

Prepackaging fresh fruits at point of production. Investigate the economic feasibility of prepackaging fresh fruits at point of production; determine the relationship of various prepackaging methods and related handling and merchandising practices to quality of product, cost of marketing, and market demand; assist producers, shippers and processors in the development and adoption of more efficient practices in the preparation and distribution of prepackaged fruits. Status: Limited studies on the prepackaging of grapes and cherries are being undertaken during the 1952 and 1953 seasons. (PMA #5)

Prepackaging fresh vegetables at point of production. Investigate the economic feasibility of prepackaging vegetables at point of production; determine the relationship of various prepackaging methods and related handling and merchandising practices to quality of product, cost of marketing, and market demand; assist producers, shippers, and processors in developing more efficient practices in the preparation and distribution of prepackaged vegetables. Status: A preliminary contract for research on prepackaging of carrots by Hermes Associates was completed and another contract for further research to increase the efficiency of packaging carrots and to determine the consumer acceptance of prepackaged carrots was executed with the Western Growers Association. (PMA #6)

Prepackaging fruits and vegetables at wholesale level. Investigate the economic feasibility of prepackaging fruits and vegetables in consumer-sized units at terminal points; to determine the relationship between various prepackaging methods and related handling and merchandising practices to such factors as quality of product, cost of marketing, and market demand; assist terminal market prepackers in the development of more efficient practices for preparing and distributing prepackaged produce. Status: Research on prepackaging of tomatoes was completed and a study to determine the possibilities of prepackaging fresh peaches in a tomato prepackaging plant was initiated in 1952, which will continue through 1953 and 1954. (PMA #7)

Prepackaging fruits and vegetables at retail level. Investigate the economic feasibility of prepackaging fruits and vegetables in consumer-sized units in self-service food stores. Measure the comparative salability and costs of direct labor, packaging materials and waste and spoilage losses of fresh fruits and vegetables prepackaged in different types, sizes, and designs of containers in relation to similar produce displayed in bulk. Status: Studies to determine the economic feasibility of prepackaging lettuce and grapes were undertaken and further studies are to be carried out during the coming year to develop more efficient methods of prepackaging lettuce in retail stores. (PMA #8)

Refrigerating fruits and vegetables at shipping point. Improve precooling methods for fruits and vegetables at shipping point, particularly vacuum cooling, hydrocooling, and tunnel cooling. Investigate each method in various types of packages; include study of package or crate arrangement. Status: Tests conducted on hydrocooling carrots after packaging in polyethylene consumer bags. Preliminary tests indicate crated strawberries can be vacuum cooled. Wrapping crates with moist crepe paper increased the rate of cooling of the berries. Project to be continued. (BPISAE #14)

Improving marketing methods and equipment for marketing facilities. Develop work methods to increase the efficiency of labor in cleaning, grading, sizing, packing, lidding, labeling, and marking farm and food products. Status: Fundamental research on grading operations under contract with University of California completed, October 1952. Report forwarded GPO, May 15, 1953. Work on apple sorting, sizing, and packing operations under contract with Washington State Apple Commission scheduled for completion late 1954 or early 1955. (PMA #9)

Prepackaging of animal and poultry products by self-service food stores. Evaluate the economic feasibility of prepackaging meat and related products by self-service food stores; assist retailers in developing and adopting efficient methods of prepackaging meat; and determine the consumer acceptance of such products. Status: Two reports were forwarded GPO, May 22. Work will continue during next fiscal year. (PMA #10)

Improving processing techniques of frozen food locker plants. Improve meat product salability through better packaging and merchandizing; conduct motion and time studies of different processing jobs, the first cutting, wrapping, and freezing meat. Status: Packaging phase inactive at present. (FCA #5)

V. OTHER INVESTIGATIONS RELATING TO PRODUCTION AND USE OF CONTAINERS

Deterioration of wood and fiber containers. Determine causes, evaluate damage and devise means for preventing or delaying the deterioration of wood and fiber containers. Status: Experiments recently begun in cooperation with the National Wood Box Association and the Frankford Arsenal of the Chief of Ordnance. Project will continue for at least two years. (BPISAE #15)

Consumption and requirements of forest products for major wood uses. Determine the consumption and probable future trend in requirements for timber and other forest products such as lumber, veneer and plywood, cooperage stock, pulpwood, ties, and fuel wood, to help determine how much timber should be grown. Status: Estimates of consumption for containers and packaging made periodically. (FS #8)

Survey of containers used for fresh fruits and vegetables. Catalogue the types and sizes of containers used for marketing fresh fruits and vegetables, and determine the extent and use of different containers. Determine the amounts and types of material used in the manufacture of fresh fruit and vegetable containers. Status: Cataloguing of the types and sizes of consumer packages and master shipping containers for tomatoes will be continued. (PMA #11)

Distributing fluid milk in paper containers in out-of-area markets. Determine the extent to which North Central States and Kentucky-produced milk is distributed in paper containers from centralized bottling plants to neighboring and distant markets; describe distribution channels and agencies used by these plants; and explore the implications and causes of development in recent years of this milk distribution system. Status: Size of container as a cost factor has been studied. Work is nearing completion. Manuscript has been prepared for publication by Illinois. (BAE #2)

Economic evaluation of farm-to-plant milk hauling in tanks. Determine by comparative analysis through case studies the relative costs under the tank and conventional can methods of milk collection. Status: Data are being gathered and will be analyzed this year. (FCA #6)

Role of farmer cooperative in the commercial fertilizer industry. Includes compiling statistical and descriptive information on methods of shipping fertilizer materials--bagged, bulk, liquid, etc. Status: New. Preliminary plans are being developed. (FCA #7)

VI. PROJECTS COMPLETED OR DISCONTINUED IN FISCAL YEAR 1952-53

Behavior of beef exposed to and protected from air in freezer storage. Determine changes in beef (1) fully exposed to air in storage; (2) frozen, sealed individually in cellophane, and returned to storage; (3) frozen, dipped, and stored; and (4) packed individually in tin plate cans, sealed in vacuum, frozen and stored. Status: Discontinued, September 1952. (BAI #5)

Packaging to reduce discoloration of dry beans, peas, and rice. Evaluate clear and colored packaging cellophane and related films; use colored and over-printed films to preserve the natural color of whole peas, split peas, dry edible beans and rice when displayed on retailers' shelves under strong light; and ascertain packaging methods and materials that will prevent checking and yellowing of rice. Status: Completed and report issued, May 1953, "Merchandising Peas and Split Peas Packaged in Transparent Films." (PMA #12)

Cost of packaging potatoes for cooperatives. To analyze the costs and methods of packaging potatoes by producers and associations of producers as a means of developing and adopting more efficient methods and practices. Status: Discontinued, September 1952. (FCA #8)

Marketing California bulk and packaged fresh vegetables. Determine advantages and disadvantages to growers, marketing agencies, and consumers of packaging fresh vegetables, factors important in setting up consumer grades for these products, and relationship between prices and quality of bulk and packaged fresh vegetables as affected by season, type of retail store, marketing channel, etc. Status: Completed. (OES #3 - Calif.)

Peanut snack and peanut spread, potential new products. A test item on one phase of this study dealt with packaging peanut butter products in a transparent pliofilm 8-ounce roll. Status: The project was completed and a report published in December 1952. (PMA #13)

Consumer preference for prepackaged cranberries. Determine the consumer preference for fresh cranberries packed in one-pound cellophane bags vs. one-pound cardboard window boxes and ascertain the reasons why customers select one type of package over the other. Also determine whether consumers would buy the package they did not select if it was the only choice available. Status: Work completed and report issued. (BAE #3)

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